19-4559; Rev 0; 4/09

MAX2163 Evaluation Kit

General Description

The MAX2163 evaluation kit (EV kit) simplifies the testing and evaluation of the MAX2163 one-segment ISDB-T tuner. The EV kit is fully assembled and tested at the factory. Standard 50Ω SMA connectors are included on the EV kit for the input and output to allow quick and easy evaluation on the test bench.

This document provides a list of equipment required to evaluate the device, a straightforward test procedure to verify functionality, a description of the EV kit circuit, the circuit schematic, a bill of materials (BOM) for the kit, and artwork for each layer of the PCB.

Features

- ♦ **Easy Evaluation of the MAX2163**
- ♦ **50Ω SMA Connectors**
- ♦ **All Critical Peripheral Components Included**
- ♦ **Fully Assembled and Tested**
- ♦ **PC Control Software (Available at www.maxim-ic.com)**

Ordering Information

PART	TYPE
MAX2163EVKIT+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C18, C26, C41–C44, C67, C68	0	Not installed, capacitors
C2, C4	2	1000pF ±10% ceramic capacitors (0402) Murata GRM1555C1H102J
C3, C6, C8, C23, C24, C34, C35, C36, C46	9	10nF ±10% ceramic capacitors (0402) Murata GRM155R71C103K
C5, C10, C16, C17, C19, C22, C29, C40, C45	9	100nF ±10% ceramic capacitors (0402) Murata GRM155R61C104K
C9, C47, C48, C50–C54, C56–C59, C61, C62, C63, C65	16	100pF ±5% ceramic capacitors (0402) Murata GRM1555C1H101J
C25	1	1.0µF ±10% ceramic capacitor (0402) Murata GRM155R60J105K
C28	1	220pF ±10% ceramic capacitor (0402) Murata GRM155R71H221K
C30	1	51pF ±10% ceramic capacitor (0402) Murata GRM1555C1H510J
C31, C32, C33	3	10µF ±10% tantalum capacitors (C-case) AVX TAJC106K016
C66	1	470nF ±10% ceramic capacitor (0402) Murata GRM155R60J474K
J2, J3, J8	3	1 x 2 headers, 2-pin headers, 0.1in centers—cut to fit Sullins PEC36SAAN
J4	1	Connector, DB25 M PCB connector HD-20 series amp 5747238-4
L2	1	18nH ±2% inductor (0402) Murata LQW15AN18NG00
L3, L4	0	Not installed, inductors
R1, R2, R4–R8, R43, R45–R48, R50, R51, R52, R54	16	100Ω ±5% resistors (0402)
R14, R25, R36, R37	4	0Ω resistors (0402)
R15	1	20kΩ potentiometer Bourns 3296W-1-203LF
R16	0	Not installed
R20	1	4.02kΩ ±5% resistor (0402)
R21	1	4.7kΩ ±5% resistor (0402)
R22	1	21kΩ ±5% resistor (0402)

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
R23, R38–R41, R55, R57, R58	8	10kΩ ±5% resistors (0402)
R29, R61	2	51Ω ±5% resistors (0402)
R30, R34, R35, R59, R60	0	Not installed, resistors
CAL, MUX, REF, VHF1, VHF2	0	Not installed
GND1, GND2, GND3, GND4, J1, J16	6	Test points, PC mini-black Keystone 5001
GC1, GC2, J13, J15, J17, PWRDET, REFOUT, TEST, VTUNE	9	Test points, PC mini-red Keystone
IFOUT, UHFIN	2	Connectors, SMA end launch jack receptacles, 0.062in Johnson 142-0701-801

DESIGNATION	QTY	DESCRIPTION
SCLCLK, SDADIN, VCCBB, VCCBIAS, VCCCP, VCCDIG, VCCLNA, VCCRF1, VCCVCO, VCCXTAL	0	Not installed
SHDNB, STBY	2	1 x 3 headers, 3-pin headers, 0.1in centers—cut to fit Sullins PEC36SAAN
U1	1	MAX2163ETI+ (28 TQFN-EP*)
U2, U5	2	SN74LV07AD hex buffers/drivers OC Texas Instruments SN74LV07AD
U3	1	Buffer Maxim MAX4217EUA+
U4	0	Not installed
Y1	1	36MHz crystal River Electec 06F36.000M8R60SJF1B
—	1	PCB: MAX2163 EVALUATION KIT+

**EP = Exposed pad.*

Component Suppliers

SUPPLIER	PHONE	WEBSITE
AVX Corporation	803-946-0690	www.avxcorp.com
Johnson Components	507-833-8822	www.johnsoncomponents.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
River Eletec Corp.	408-236-7410	www.river-ele.co.jp
Texas Instruments Inc.	972-644-5580	www.ti.com

Note: *Indicate that you are using the MAX2163 when contacting these component suppliers.*

Quick Start

The MAX2163 EV kit is fully assembled and factory tested. Follow the instructions in the *Connections and Setup* section for proper device evaluation.

Test Equipment Required

- One power supply capable of supplying at least 100mA at +2.5V
- One dual-output power supply capable of supplying at least 100mA at +3V and -3V
- One RF signal generator capable of delivering at least 0dBm of output power at frequencies up to 1GHz
- One RF spectrum analyzer capable of covering the operating frequency range of the device
- A PC with Windows® 2000, NT 4.0, XP® or later operating system, 64MB of memory, and an available parallel port
- A 25-pin parallel cable
- One dual-output power supply capable of supplying up to 2.5V at < 1mA (to apply gain-control voltages directly)
- (Optional) One multichannel digital oscilloscope
- (Optional) A network analyzer to measure return loss
- (Optional) An ammeter to measure supply current

Connections and Setup

This section provides a step-by-step guide to testing the basic functionality of the EV kit in UHF mode. **Do not turn on DC power or RF signal generators until all connections are completed.**

1) With its output disabled, set the DC power supply to +2.5V. Connect the power supply to the VCC (J13) (through an ammeter if desired) and GND (J1) terminals on the EV kit. If available, set the current limit to 75mA.
2) With its output disabled, set the dual-output DC power-supply voltages to +3V and -3V. Connect the +3V, -3V, and GND terminals of the power supply to jumpers J15, J17, and J16, respectively. If available, set the current limits to 50mA.
3) With its output disabled, set the RF signal generator to a 557.143MHz frequency and a -100dBm power level. Connect the output of the RF signal generator to the SMA connector labeled UHF on the evaluation board.
4) Connect a 25-pin parallel cable between the PC's parallel port and the MAX2163 evaluation board.
5) Turn on the ±3V power supply, followed by the +2.5V power supply. The supply current from the +2.5V supply should read approximately 35mA. Be sure to adjust the power supply to account for any voltage drop across the ammeter.
6) Connect the power-supply outputs to GC1 and GC2. Adjust voltages at GC1 and GC2 to approximately +0.3V.
7) Install and run the MAX2163 control software. Software is available for download on the Maxim website at www.maxim-ic.com.
8) Load the default register settings from the control software by clicking the Defaults tab at the top of the screen.
9) Connect the IFOUT output to a spectrum analyzer or to an oscilloscope. Set the oscilloscope for 50Ω input impedance.
10) Enable the RF signal generator's output.
11) If using a spectrum analyzer, set the center frequency of the analyzer to 571kHz and a span of 100kHz. Set the reference level to 0dBm. Adjust the input power of the signal generator until the output level reaches -9dBm. This is the nominal output level for the IF output. The gain of the receiver can be calculated by taking the difference in decibels between the input and output power.

    If using an oscilloscope, observe the 571kHz sine wave. Adjust the input power of the signal generator until the IF output reaches 225mV_{P-P}. This is the nominal output level for the IF output.

    Voltage gain can be calculated by:

    $$Gain = 20 \times \log(V_{OUT\_P-P}/(2 \times sqrt(2) \times V_{IN\_RMS}))$$

    where $V_{IN\_RMS} = sqrt(50 \times 10^{[(Pin (dBm) - 30)/10]})$

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Output Buffer

The MAX2163 EV kit has a buffer with a voltage gain of 2 at the IF output to allow easy interfacing with 50Ω test equipment. The buffer has a 50Ω resistor (R29) in series with the output for back-termination. When the IF output from the EV kit is loaded with a 50Ω test instrument, a voltage-divider is formed by the 50Ω back-termination resistor and the 50Ω test instrument input impedance, dividing the output signal by 2 and negating the effect of the buffer's gain of 2.

When making measurements with an instrument that has a high input impedance, there is no voltage-divider at the output and the signal level at the output of the board is twice the signal level at the IF output of the MAX2163 due to the output buffer gain. This extra gain must be accounted for when making measurements with high-impedance test equipment.

RF Gain-Control Range (GC1)

To measure the gain-control range in the RF stage, follow the steps below:

1) Set V_{GC2} = 1.5V.
2) Set V_{GC1} = 0.3V.
3) Adjust the RF input power to achieve -9dBm at the IF output. Record this as the reference output level.
4) Set V_{GC1} = 2.1V, and record the change in the IF output level in dB relative to -9dBm. This change in output power is the gain-control range of the RF stage.
5) The RF gain-control range is at least 40dB.
6) Note that it may be necessary to increase the input power level with V_{GC1} = 2.1V to make an accurate level measurement. If this is necessary, calculate the RF gain-control range by first calculating the gain with V_{GC1} = 0.3V, then calculate the gain with V_{GC1} = 2.1V, and take the difference between these two gain levels.

Baseband Gain-Control Range (GC2)

To measure the gain-control range in the baseband stage, follow the steps below:

1) Set V_{GC1} = 1.5V.
2) Set V_{GC2} = 0.3V.
3) Adjust the RF input power to achieve -9dBm at the IF output. Record this as the reference output level.
4) Set V_{GC2} = 2.1V, and record the change in the IF output level in dB relative to -9dBm. This change in output power is the gain-control range of the baseband stage.
5) The baseband gain-control range is at least 62dB.
6) Note that it may be necessary to increase the input power level with V_{GC2} = 2.1V to make an accurate level measurement. If this is necessary, calculate the baseband gain-control range by first calculating the gain with V_{GC2} = 0.3V, then calculate the gain with V_{GC2} = 2.1V, and take the difference between these two gain levels.

Input Signal Range

To measure the dynamic range of the receiver, follow the steps below:

1) Set the RF input power to -120dBm. Set to the maximum system gain (V_{GC1} = V_{GC2} = 0.3V).
2) Slowly increase the RF input power until the IF output reaches -9dBm (225mV_{P-P}). The RF input power at this point is the lower end of the receiver's input signal range.
3) Set to the minimum system gain (V_{GC1} = V_{GC2} = 2.1V) and set the RF input power to -10dBm. Slowly increase the RF input power until the IF output reaches -16dBm (100mV_{P-P}). The RF input power at this point is the upper end of the receiver's input signal range.

Layout Considerations

The MAX2163 evaluation board can serve as a reference board layout. Keep traces carrying RF signals as short as possible to minimize radiation and insertion loss. Place supply-decoupling capacitors as close as possible to the device. Solder the package's exposed paddle evenly to the board ground plane for a low-inductance ground connection and for improved thermal dissipation.

The ground returns for the VCO, VTUNE, and charge pump require special layout consideration. The LDO capacitor (C66) and the VCCVCO bypass capacitor (C17) ground returns must be routed back to the ground pad near pins 27 and 28. All loop filter component grounds (C27, C28, C30) and the VCCSYN bypass capacitor (C19) ground must be routed together back to the GNDSYN pin. The GNDSYN pin must then be connected to the overall ground plane. See Figures 2 through 9 for recommended board layout.

The ground connection of the bypass capacitor on the VCCSYN power-supply input also requires careful consideration. Placing the ground connection too close to the UHFIN input can cause noise on the VCCSYN line to couple into the RF inputs resulting in degraded performance. Bypassing of the VCCSYN power-supply input can be removed if necessary to prevent noise from coupling into the RF inputs.

To ensure proper crystal oscillator startup, place the crystal near the MAX2163 XTAL pin (pin 21). The crystal ground should have a clear, short return back to the MAX2163 ground paddle near XTAL. Minimize the parasitic capacitance (< 0.5pF) between the board traces of XTAL (pin 21) and XTALOUT (pin 22).

MAX2163 Evaluation Kit

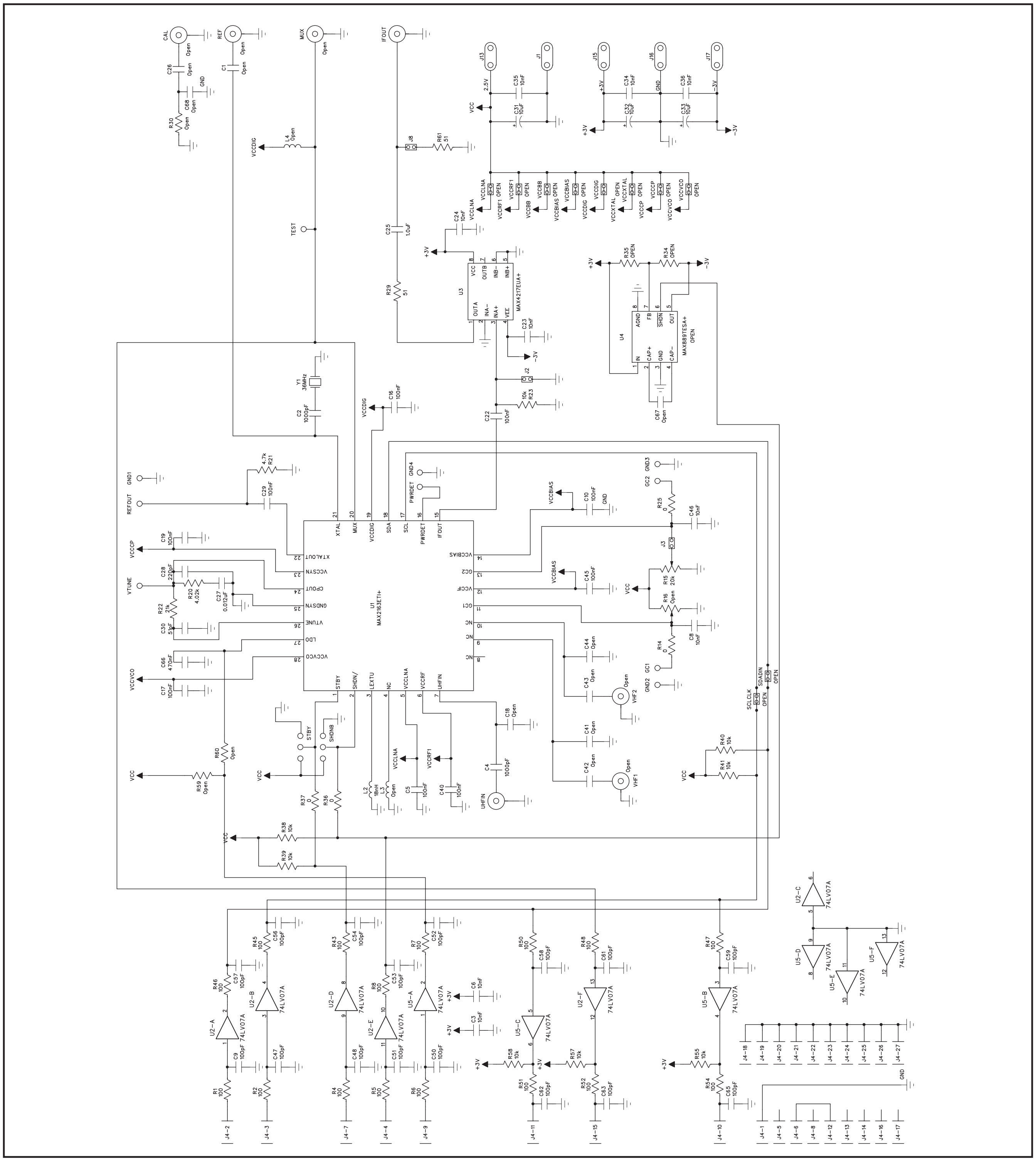

Figure 1. MAX2163 TQFN EV Kit Schematic

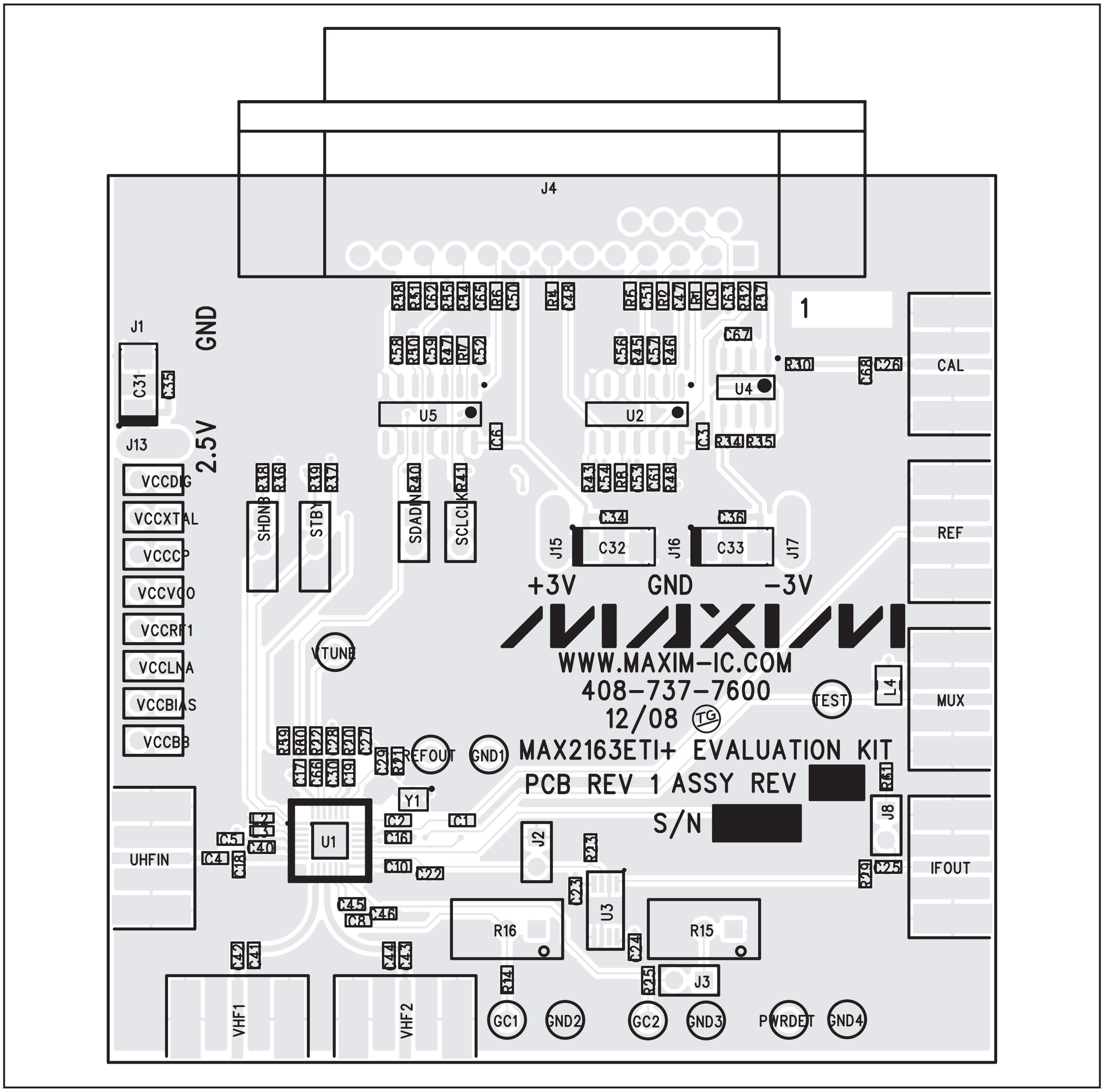

Figure 2. MAX2163 TQFN EV Kit PCB Layout—Component Placement Guide

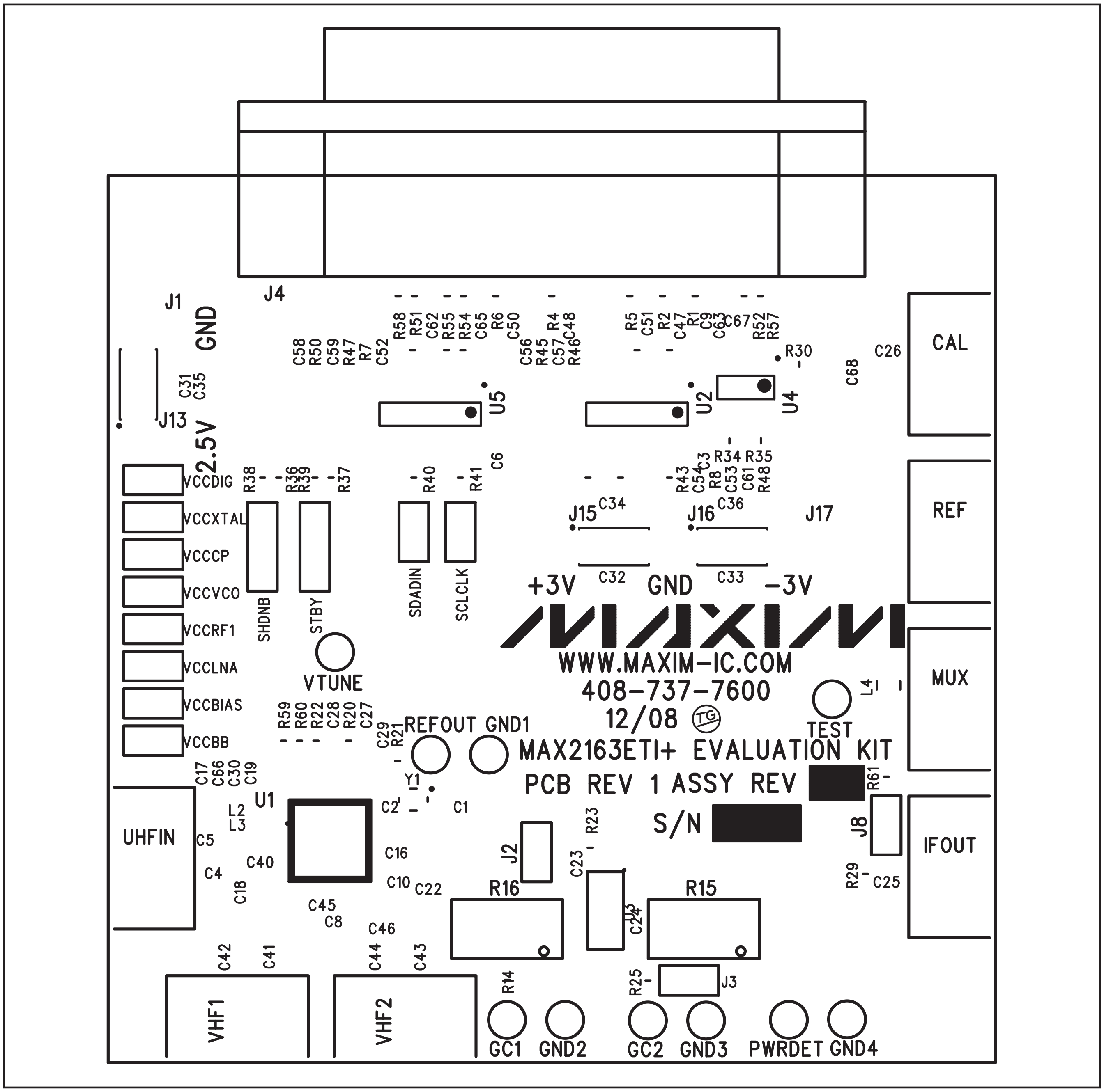

Figure 3. MAX2163 TQFN EV Kit PCB Layout—Top Silkscreen

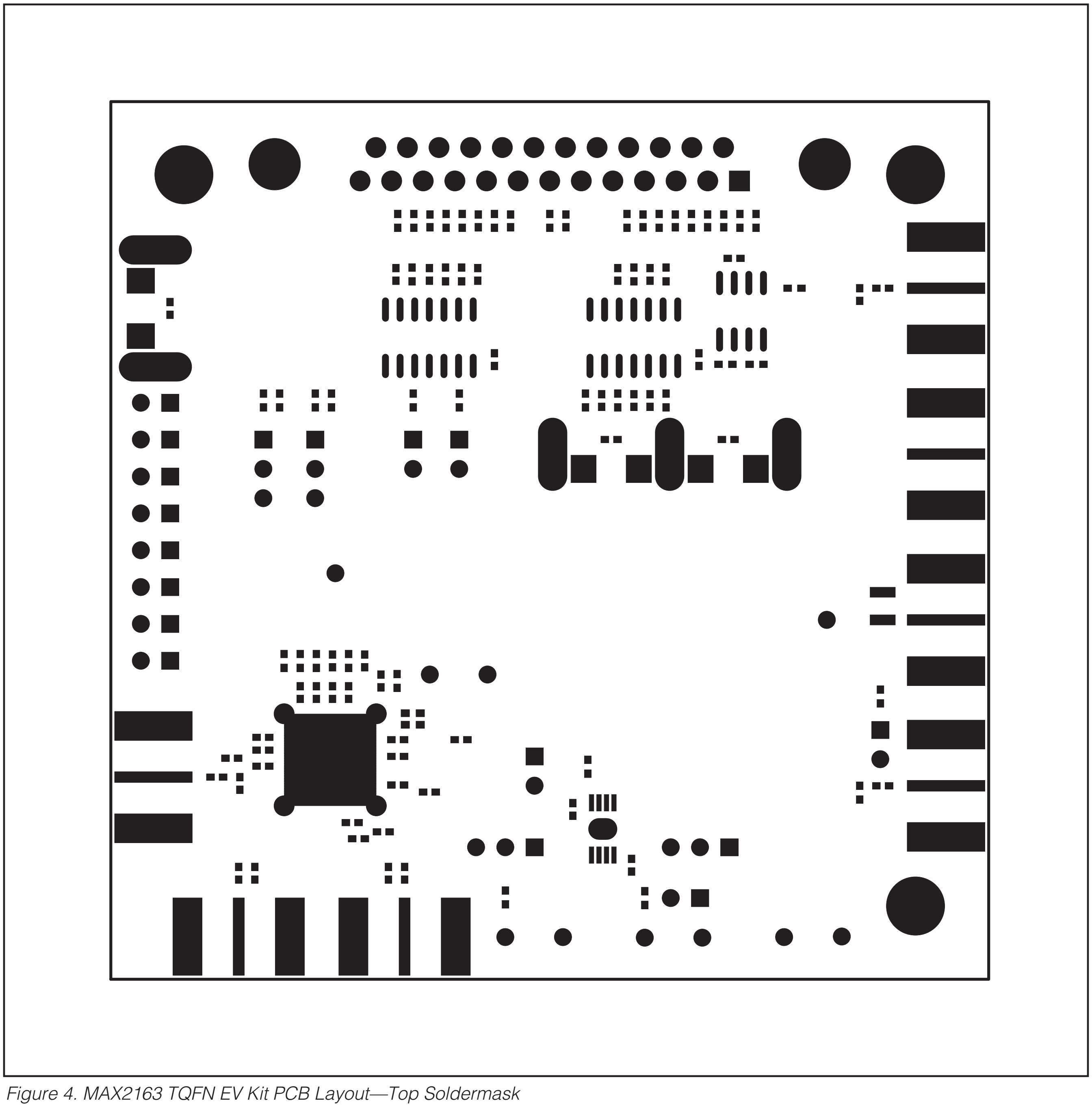

Figure 4. MAX2163 TQFN EV Kit PCB Layout—Top Soldermask

MAX2163 Evaluation Kit

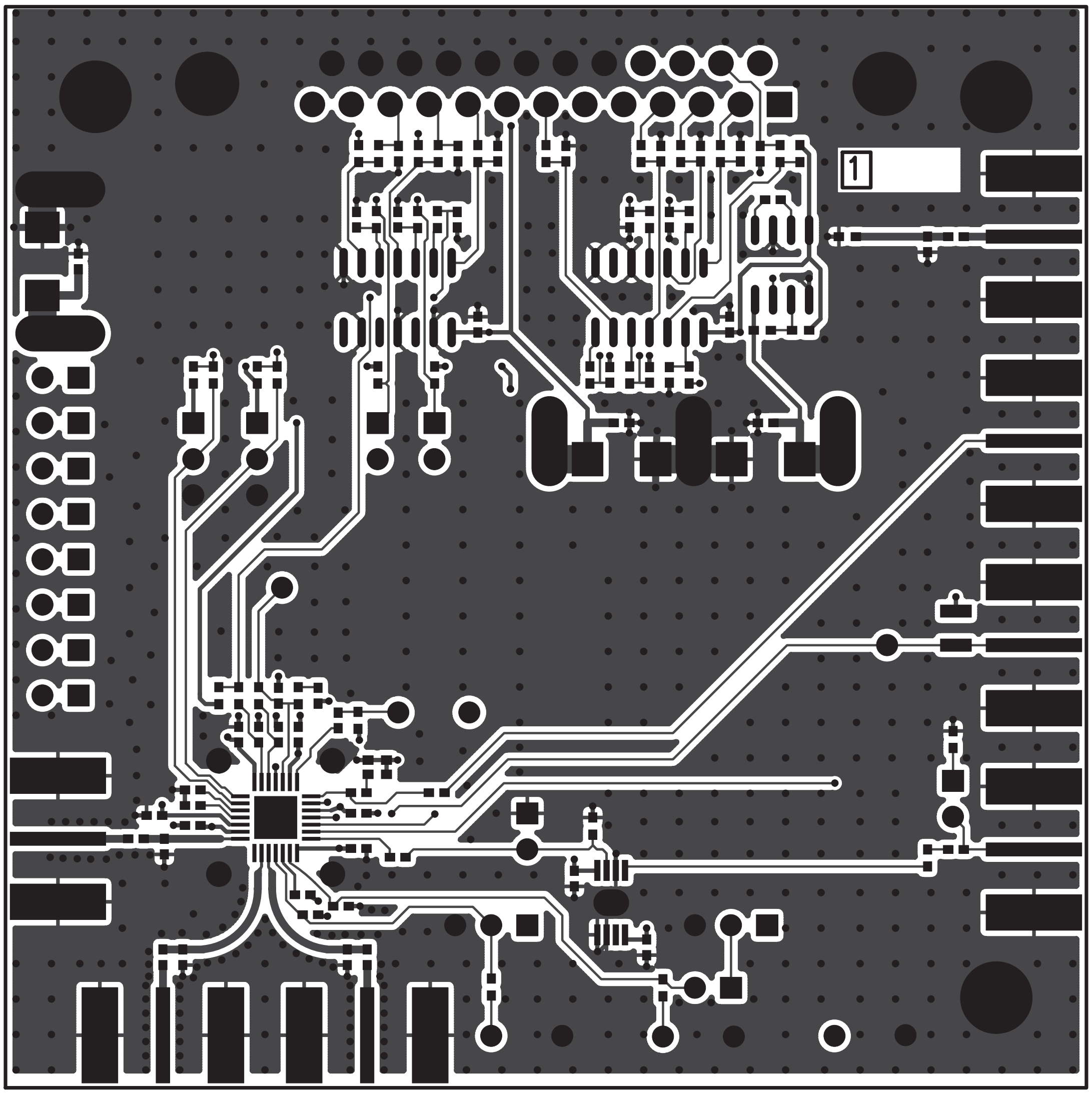

Figure 5. MAX2163 TQFN EV Kit PCB Layout—Primary Component Side

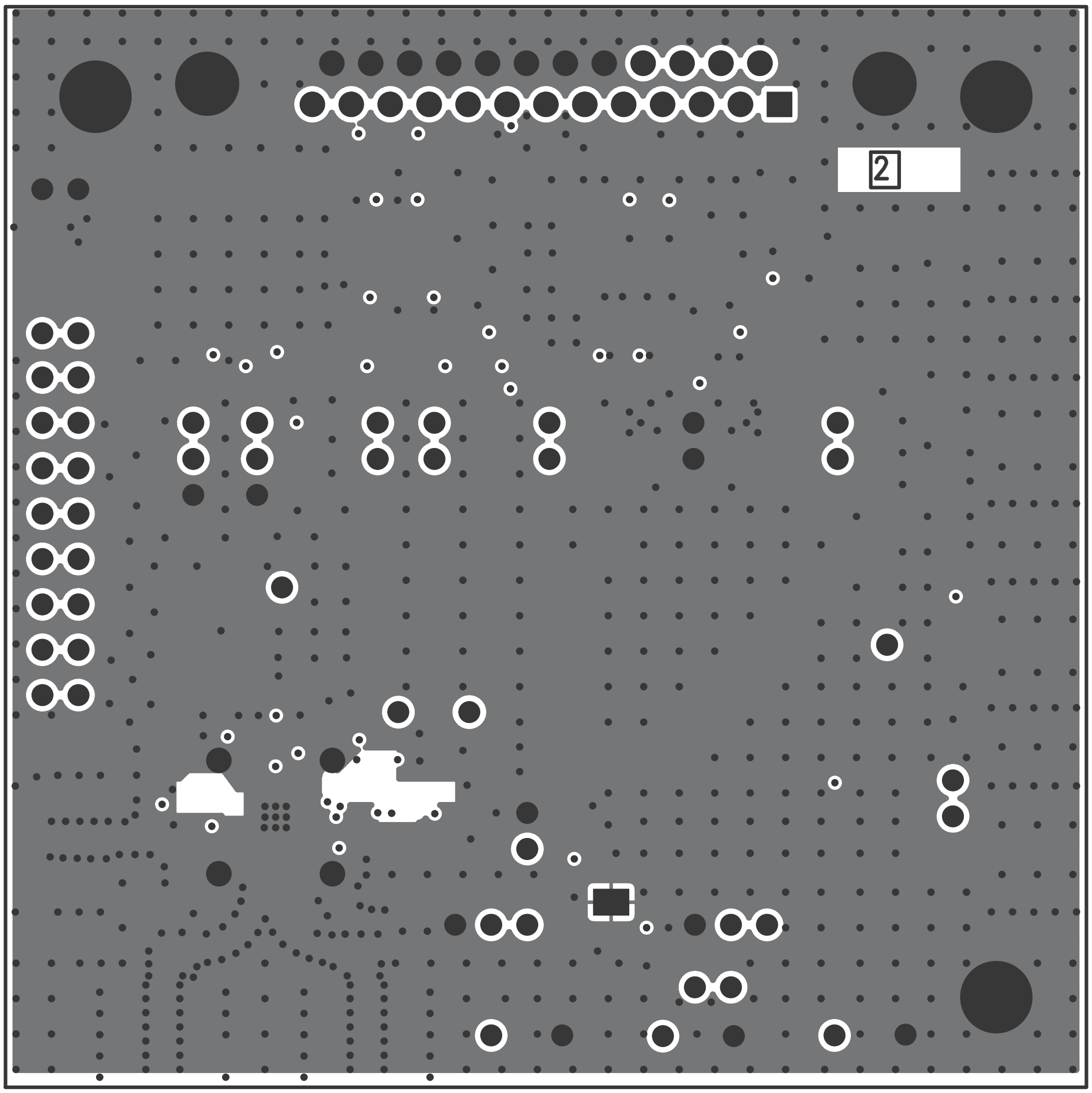

Figure 6. MAX2163 TQFN EV Kit PCB Layout—Inner Layer 2

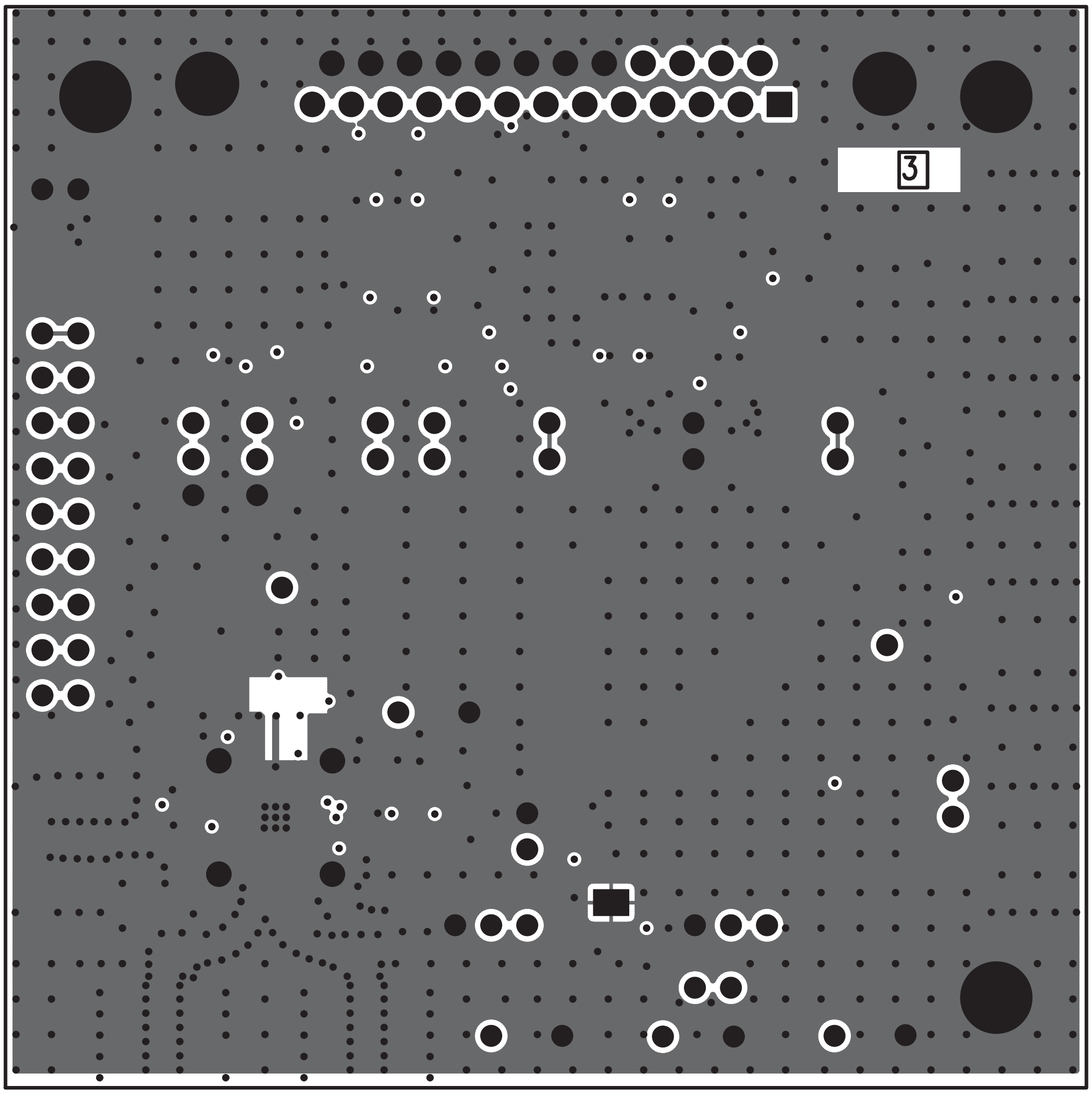

Figure 7. MAX2163 TQFN EV Kit PCB Layout—Inner Layer 3

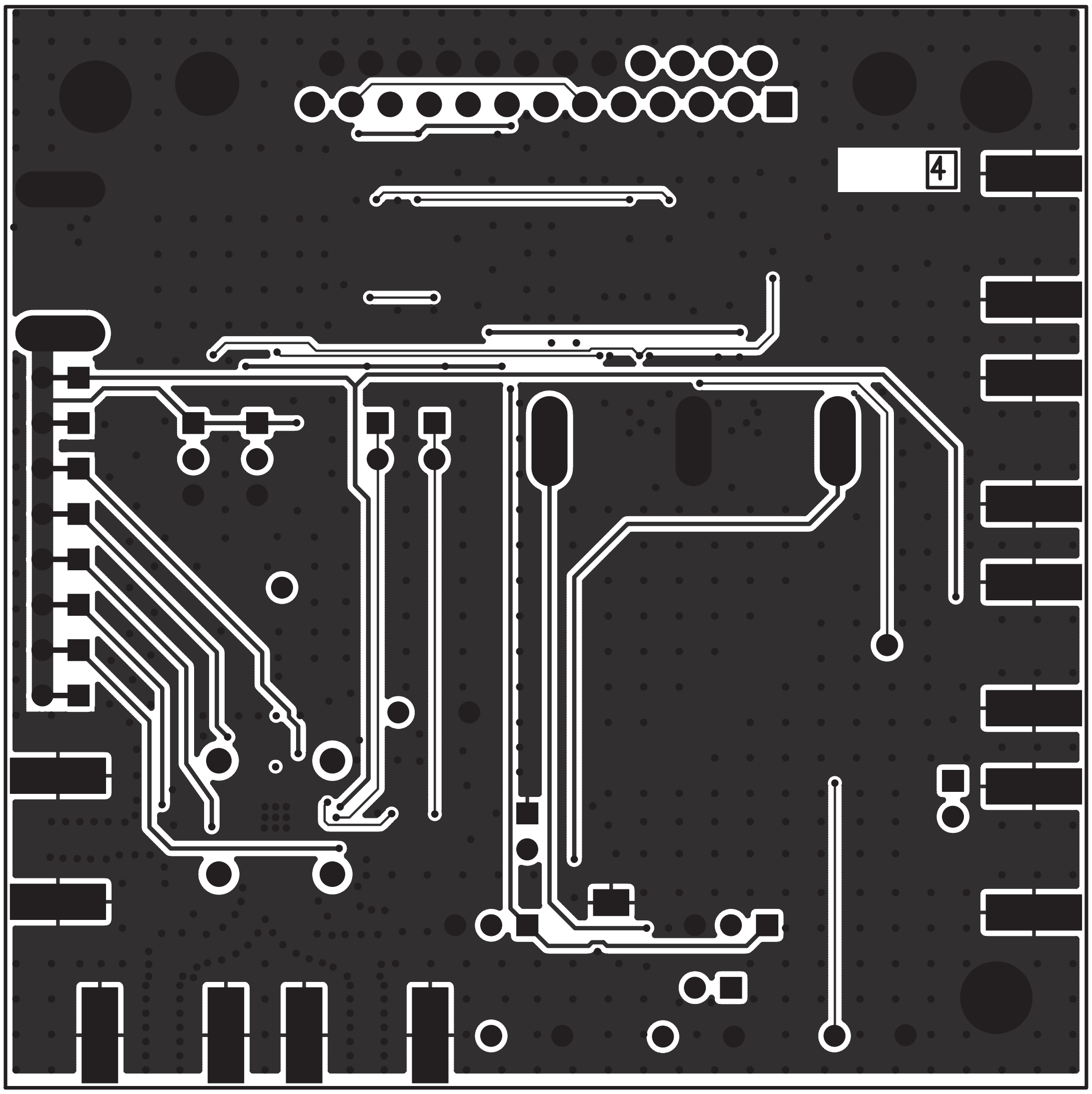

Figure 8. MAX2163 TQFN EV Kit PCB Layout—Secondary Component Side

MAX2163A Evaluation Kit

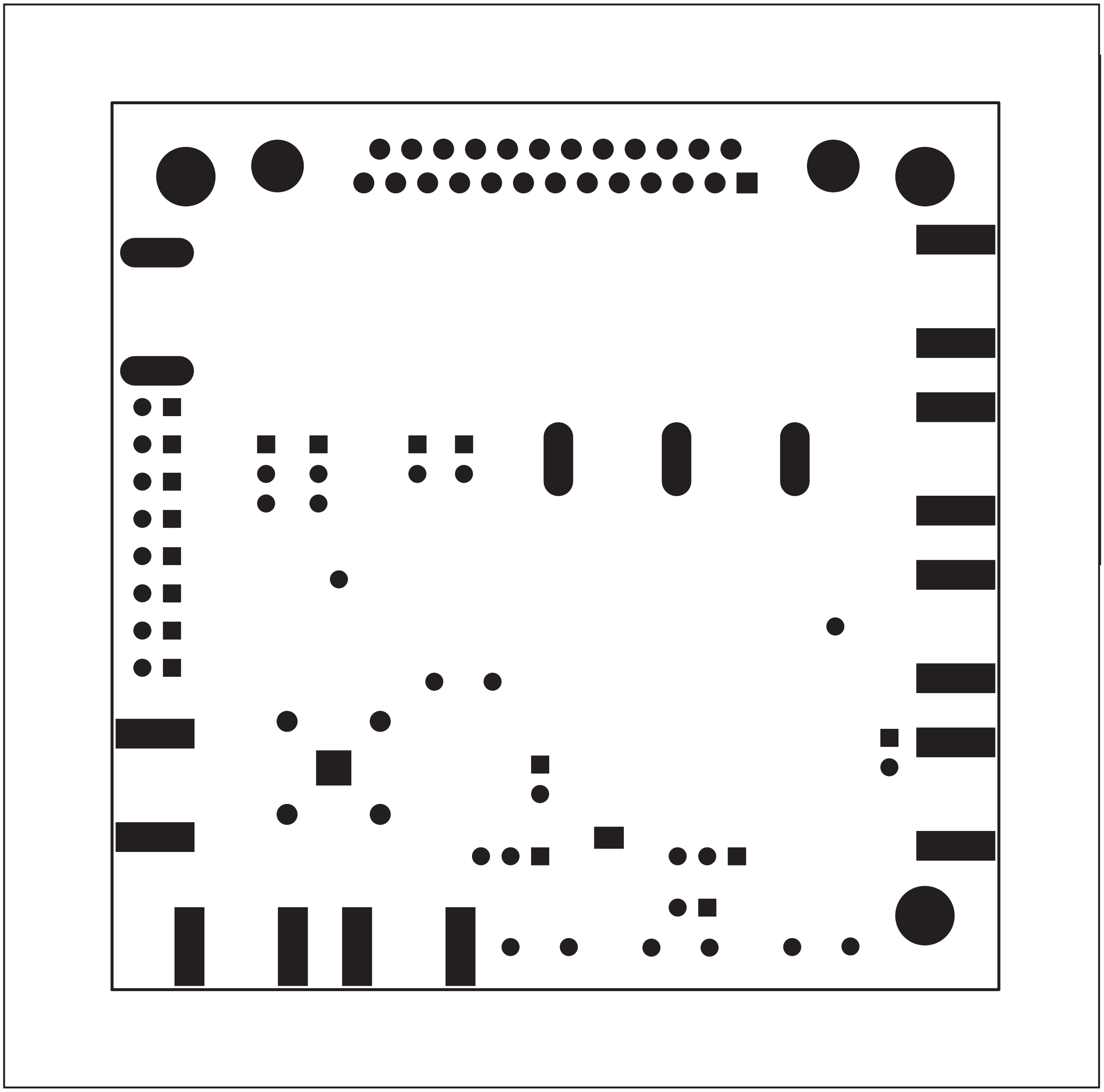

Figure 9. MAX2163 TQFN EV Kit PCB Layout—Bottom Soldermask